

REMARKS

Applicants appreciate the detailed examination evidenced by the Official Action dated April 12, 2002 (hereinafter "the Official Action"). In response, Applicants have amended independent Claim 1 to recite in-part:

forming a mask on the isolation region that extends onto a portion of the substrate adjacent to the isolation region to provide a shielded portion of the substrate adjacent to the isolation region and an exposed portion of the substrate spaced apart from the isolation region having the shielded portion therebetween;
forming a channel region in the exposed portion of the substrate;

forming a plurality of gate electrodes on the channel region; and

implanting ions using the plurality of gate electrodes as an implant mask to form source/drain regions associated with the plurality of gate electrodes and to define separate channel regions from the channel region that are self-aligned to the plurality of gate electrodes.

Applicants have amended dependent Claim 2 to further clarify that the first and second level of ions are first and second concentrations of ions as suggested by the Examiner.

Applicants have amended several passages of the specification to correct minor typographical errors therein. In particular, the unique legends used to refer to results in the graph shown in Figure 9 have been added to the specification.

Applicants have also canceled Claims 4 – 16 and have added new Claims 17 – 23, the recitations of which are neither disclosed nor suggested by the prior art. Applicants respectfully submit that all pending claims are patentable for at least the reasons discussed herein.

Amended Claim 2 complies with 35 U.S.C. § 112.

Claim 2 stands rejected under 35 U.S.C. § 112, second paragraph. *Official Action, page 2.* In response, Applicants have amended dependent Claim 2 as suggested by the Examiner to recite "first and second ion **concentrations.**" Accordingly, dependent Claim 2 complies with 35 U.S.C. § 112, second paragraph.

Amended independent Claim 1 is patentable over Odake.

Claims 1 and 2 stand rejected under 35 U. S.C. § 102(e) over U.S. Patent No. 6,165,825 to Odake ("Odake"). *Official Action*, pages 2 – 3. In response, Applicants have amended independent Claim 1 to recite in-part:

forming a mask on the isolation region that extends onto a portion of the substrate adjacent to the isolation region to provide a shielded portion of the substrate adjacent to the isolation region and an exposed portion of the substrate spaced apart from the isolation region having the shielded portion therebetween;

forming a channel region in the exposed portion of the substrate;

forming a plurality of gate electrodes on the channel region; and

implanting ions using the plurality of gate electrodes as an implant mask to form source/drain regions associated with the plurality of gate electrodes and to define separate channel regions from the channel region that are self-aligned to the plurality of gate electrodes.

As understood by Applicants, Odake discusses the formation of single gate structure between adjacent portions of the LOCOS layer 2 as shown, for example, in Figure 5(f) of Odake. Furthermore, Figures 5(a) – 5(e) of Odake appear to show formation of a single control layer 10 that functions as a channel region for the single transistor structure shown in Figure 5(f). Therefore, as understood by Applicants, Odake does not disclose or suggest forming a **plurality of gate electrodes on the channel region** and implanting ions "**to define separate channel regions from the channel region that are self aligned to the plurality of gate electrodes**" as recited in amended independent Claim 1. For example, Figure 5(f) of Odake shows only one channel, not separate channels as recited in amended independent Claim 1. Accordingly, Odake does not disclose the recitations of amended independent Claim 1.

New Claims 17-23 are patentable.

Applicants have added new Claims 17 – 23 herein, the recitations of which are neither disclosed nor suggested by the prior art. For example, new dependent Claim

17 recites in-part that "**at least one of the source/drain regions is in the exposed portion.**" For example, Otake discusses the formation of a transistor structure with the associated source/drain regions formed in the regions shielded by the Pr21 layer as shown, for example, Figures 5(a) and 5(f) of Otake. In contrast, the source/drain region 142a, shown, for example in Figure 8 of the present application, is formed in the exposed portion (between the regions shielded by the mask 110 shown in Figure 5). Accordingly, Otake does not disclose the recitations of new Claim 17.

Otake also does not disclose the recitations of new independent Claim 21, which recites in-part:

forming a mask on first and second adjacent isolation regions in an integrated circuit substrate and extending onto an active area between the first and second adjacent isolation regions to define first and second shielded portions of the substrate adjacent to the first and second isolation regions and an exposed portion of the substrate therebetween;

forming a single channel region in the exposed portion of the substrate;

forming a plurality of gate electrodes on the single channel region; and

implanting ions using the plurality of gate electrodes as an implant mask to form source/drain regions associated with the plurality of gate electrodes and to form first and second spaced apart channel regions from the single channel region.

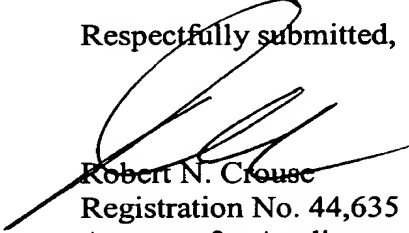
As discussed above, Otake does not disclose forming a plurality of gate electrodes on the control layer 10 that functions as a channel region. *See, for example, col. 11, lines 65-67.* Furthermore, Otake does not disclose implanting ions to "**form first and second spaced apart channel regions from the single channel region.**" Accordingly, new independent Claim 21 is patentable. Furthermore, new dependent Claims 18-20 and 22-23 are patentable at least per the patentability of independent Claims 1 and 21.

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Filed: June 26, 2001
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CONCLUSION

Applicants respectfully submit that the pending claims are patentable and request the allowance of all claims in due course. If any informal matters arise the Examiner is encouraged to contact the undersigned by telephone at (919) 854-1400.

Respectfully submitted,


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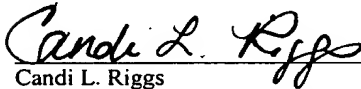


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Candi L. Riggs

Date of Signature: July 8, 2002

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Sir:

The following is an addendum to the concurrently filed amendment in response to an Official Action dated April 12, 2002 in the above referenced application. This addendum includes a marked-up version of the changes made to the claims by the present amendment.

In the Specification:

The paragraphs beginning on page 7, line 13 and ending on page 8, line 7 have been amended as follows:

--During channel ion-implantation, boron ions were implanted into a portion over which a gate electrode would be formed and into a portion where a source/drain region connected to a bit line contact would be formed in an active region at a dose of about $1.0\text{E}13/\text{cm}^2$ and with ion-implantation energy of about 30KeV in a first local ion-implantation step. Then boron difluoride ions were implanted into the portion over which the gate electrode would be formed and the portion where the source/drain region connected to the bit line contact would be formed in the active region at a dose of about $1.2\text{E}13/\text{cm}^2$ and with ion-implantation energy of about 30KeV in a second local ion-implantation process. This case is represented by [-_-] -O- in the graph of FIG. 9. In another case, dual channel ion-implantation was performed under the same conditions as the above case, but channel ion-implantation was performed on an entire active region as in the prior art described in FIG. 1. This case is represented by [-_-] -●- in the graph of FIG. 9. The two cases are represented by the numbers of accumulated failed cells according to refresh time.

In addition, during channel ion-implantation, boron ions were implanted into a portion over which a gate electrode would be formed and into a portion where a source/drain region connected to a bit line contact would be formed in an active region at a dose of about $1.0\text{E}13/\text{cm}^2$ and with ion-implantation energy of about

30KeV in a first local ion-implantation step, and then boron difluoride ions were implanted into only the portion over which the gate electrode would be formed and the portion where the source/drain region connecting to the bit line contact would be formed in the active region at a dose of about $1.5 \times 10^{13}/\text{cm}^2$ and with ion-implantation energy of about 30KeV in a second local ion-implantation process. This case is represented by -▽- in the graph of FIG. 9. In another case, dual channel ion-implantation was performed under the same conditions as the above case, but the channel ion-implantation was performed on an entire active region as in the prior art described in FIG. 1. This case is represented by [- -] -▽- in the graph of FIG. 9. The two cases are represented by the numbers of accumulated failed cells according to refresh time.--

In the Claims:

Claims 1-3 have been amended as follows:

1. (Amended) A method of forming a channel region between isolation regions of an integrated circuit substrate, the method comprising:

forming a mask on the isolation region that extends onto a portion of the substrate adjacent to the isolation region to provide a shielded portion of the substrate adjacent to the isolation region and an exposed portion of the substrate spaced apart from the isolation region having the shielded portion therebetween; [and]

forming a channel region in the exposed portion of the substrate;

forming a plurality of gate electrodes on the channel region; and

implanting ions using the plurality of gate electrodes as an implant mask to form source/drain regions associated with the plurality of gate electrodes and to define separate channel regions from the channel region that are self-aligned to the plurality of gate electrodes.

2. (Amended) A method according to Claim 1 wherein the forming the channel region comprises:

implanting a first concentration [level] of ions in the shielded region adjacent to the isolation region; and

wherein the implanting ions comprises implanting a second concentration [level] of ions in the channel region spaced apart from the isolation region, wherein the second concentration [level] is greater than the first concentration [level].

3. (Amended) A method according to Claim 1 wherein the forming a channel region comprises[:]

implanting boron ions in the exposed portion [region; and then
implanting boron difluoride ions in the exposed region].

Claims 4-16 have been canceled without prejudice or disclaimer.

Claims 17-23 have been added.

****END****